

Amendment and Response

Applicant: Paul Lecoq

Serial No.: 10/696,550

Filed: October 29, 2003

Docket No.: K316.106.101

Title: PET-SCANNER

IN THE DRAWINGS

The attached two (2) Replacement Sheets of drawings include change to FIGS. 2 and 6 as follows:

- In FIG. 2, the text labels on elements 18 and 20 have been changed from "LuAP" to --LuYAP--.
- In FIG. 6, the text labels on elements 30 and 32 have been changed from "LuAP" to --LuYAP--.

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REMARKS

The following remarks are made in response to the non-final Office Action mailed December 6, 2005, in which claims 1-19 were rejected. With this Response, claims 4-6 have been amended, claims 2, 7-12 and 16-19 have been cancelled, and new claim 20 has been added. Claims 1, 3-6, 13-15 and 20 remain pending in the application and are presented for reconsideration and allowance.

Objections to the Drawings

The drawings have been objected to under 37 C.F.R. §1.83(a) for failing to show every feature of the invention specified in the claims. The Office Action states the use of LuYAP scintillators must be shown or the feature canceled from the claims.

With this Response, FIGS. 2 and 6 have been amended to read "LuYAP" in lieu of "LuAP". Basis for the amendment to FIG. 2 can be found at page 9, line 16 of the application as filed (identifying "layer of LuYAP 18, 20"). Basis for the amendment to FIG. 6 can be found at page 11, line 25 of the application as filed (identifying "LuYAP layer 30, 32").

In view of the amendments to FIGS. 2 and 6 described above and presented in the attached Replacement Sheets, withdrawal of the objections to the drawings is respectfully requested.

Objections to the Specification

The disclosure has been objected to because of informalities. In particular, the Office Action finds that the disclosure includes numerous references to figures, graphs and tables supposedly identifying LuYAP scintillators and/or properties thereof, however none of the figures, graphs or tables include LuYAP scintillators.

As described above in addressing the Objections to the Drawings, FIGS. 2 and 6 have been amended to correctly identify the LuYAP scintillators. Accordingly, withdrawal of the objections to the specification is respectfully requested.

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Objections to the Claims

Claim 19 stands objected to under 37 CFR 1.75(c) as being of improper dependent form for failing to further limit the subject matter of a previous claim.

With this Response, claim 19 has been cancelled from the application.

Claim Rejections under 35 U.S.C. § 112

Claims 1-19 stand rejected under 35 U.S.C. § 112, first paragraph, because the Office Action alleges the specification, while being enabling for devices utilizing scintillators such as LSO, LuAP and GSO, for example, does not reasonably provide enablement for LuYAP scintillators and/or the advantage thereof. In particular, the Office Action states that while the specification includes numerous references to LuYAP scintillators and the properties thereof which suggest the suitability of the scintillators for use in PET imaging systems, the drawings do not provide support for the alleged properties.

As described above in addressing the Objections to the Drawings, FIGS. 2 and 6 have been amended to correctly identify the LuYAP scintillators in the drawings. Accordingly, it is respectfully submitted that the specification is enabling for LuYAP scintillators, and withdrawal of the rejections is respectfully requested.

Regarding claim 6 (dependent on claim 3), the Office Action states there is insufficient antecedent basis for the limitation "the determining means." The Office Action notes that a determining means is first recited in claim 5, which is not in the chain of dependency of claim 6.

With this Response, claim 6 has been amended to provide proper antecedent basis for "determining means," and withdrawal of the rejection is respectfully requested.

Claim Rejections under 35 U.S.C. § 103

Claim 1-6, 13 and 17-19 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Chen et al. (U.S. Patent No. 6,528,793) in view of Chval et al. (Development of New Mixed $\text{Lu}_x(\text{RE}^{3+})_{1-x}\text{AP}$: Ce Scintillators).

Claims 2 and 17-19 have been cancelled from the application. In view of the cancellation of claim 2, claim 5 has been amended to change its dependency from claim 2 to claim 3.

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Regarding claim 1, with reference to FIGS. 1 and 2, Chen is alleged to disclose a positron emission tomography camera or scanner (10) comprising: a patient area, a detector ring (18) for detecting radiation from opposite sides of the patient area, the ring including a plurality of scintillation detectors (16) directed towards the patient area, the scintillation detectors being such as to emit light when radiation is incident thereon (said to be an inherent property of scintillators), and converting means (referencing PMTs – col. 9, line 36) optically coupled to the scintillation detectors (16) for converting light emitted by the scintillation detectors to electrical pulses, wherein each of the plurality of scintillation detectors comprises LSO or GSO (referencing col. 9, lines 26-30).

Regarding the material being lutetium-yttrium-aluminate-perovskite, $\text{Lu}_x\text{Y}_{1-x}\text{AP}$ (where $0.5 \leq x \leq 0.995$), Chval is alleged to disclose an alternative scintillator crystal for PET systems comprising lutetium-yttrium-aluminate-perovskite, $\text{Lu}_x\text{Y}_{1-x}\text{AP}$ scintillator crystal (referencing p. 332, para. 2-3) with properties that meet or exceed those of other well known scintillators such as GSO (referencing p. 339, para. 2). Regarding the claimed range of lutetium as $0.5 \leq x \leq 0.995$, the Office Action alleges that although the specific embodiments of Chval show values of $x \leq 0.3$ (referencing Table 4), Chval further teaches that in PET imaging applications the concentration of lutetium should be increased significantly to the point that the Yttrium content is at its lowest concentration possible to preserve the perovskite phase during growth (referencing p. 341, para. 1). Thus, the Office Action concludes it would have been obvious to a person of ordinary skill in the art to modify the system of Chen in view of Chval so as to utilize a mixed LuYAP scintillator with improved performance and high stopping power.

The rejection of claim 1 under 35 U.S.C. §103(a) is respectfully traversed. To establish a *prima facie* case of obviousness, three basic criteria must be met:

- (1) There must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference to combine reference teachings;
- (2) There must be reasonable expectation of success;
- (3) The prior art reference (or references when combined) must teach or suggest all the claim limitations.

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The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not based on Appellant's disclosure. See *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (F.E.D. Cir. 1991).

Applicants respectfully submit that the combination of references cannot support a case of prima facie obviousness as to the claims because, among other possible reasons, the references fail to disclose all of the elements of the present invention, there is no motivation to combine the reference teachings, and one skilled in the art would have no reasonable expectation of success when combining the references as suggested in the Office Action.

A feature of the present invention is that each of the plurality of the scintillation detectors comprises $\text{Lu}_x\text{Y}_{1-x}\text{AP}$, where $0.5 \leq x \leq 0.995$. Chen discloses an accurate image reconstruction for a depth-of-interaction positron emission tomography system that employs LSO/GSO bilayer depth-of-interaction (DOI) detector modules which appear to be well known in the art. As recognized in the Office Action, Chen fails to teach or suggest that each of the plurality of the scintillation detectors comprises $\text{Lu}_x\text{Y}_{1-x}\text{AP}$, where $0.5 \leq x \leq 0.995$.

The Office Action alleges that Chval overcomes the deficiencies of Chen. Chval describes the development of Ce-doped, fast and high effective-Z mixed $\text{Lu}_x(\text{RE}^{3+})_{1-x}\text{AP}:\text{Ce}$ crystals. However, Chval only cites values of x equal to 0.1, 0.2 and 0.3 (for Y^{3+} ions) giving good results. Although there is no teaching in Chval that x may be greater or equal to 0.5 (as recited in claim 1), the Examiner cites paragraph 1 of page 341 of Chval (stating that "to improve the stopping power of the mixed orthoaluminate crystals it requires to increase significantly their lutetium content") as suggesting that x may be greater or equal to 0.5.

Applicant respectfully submits that a person of ordinary skill in the art, when reviewing Chval would not consult the cited paragraph in isolation. Indeed, Chval (section 2, in the paragraph spanning pages 332 and 333), clearly states:

"Large crystals ... of good quality were grown for $\text{Lu}_x(\text{RE}^{3+})_{1-x}\text{AP}:\text{Ce}$ with $x = 0.1, 0.2$ and 0.3 . These crystals were almost free of extended defects and moreover no garnet phase appeared. ... Attempts to grow pure $\text{LuAP}:\text{Ce}$ crystal were unsuccessful and only garnet phase appeared."

Clearly, Chval as a whole teaches away from the solution reached by the present invention wherein x lies between 0.5 and 0.995. Furthermore, the teachings of Chval suggest

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there is no reasonable expectation of success that x greater than 0.5 would give anything other than crystals having polycrystalline character with bubbles, precipitates and other mechanical distortions and garnet phase on their surfaces which would render them of no use in a positron emission tomography camera or scanner according to the present invention.

In summary, not all claim limitations are taught by the prior art, the prior art teaches away from the solution reached in the present invention and furthermore there is no reasonable expectation of success which would lead a person of ordinary skill in the art to arrive at the present invention. For at least these reasons, reconsideration and withdrawal of the rejection of independent claim 1 under 35 U.S.C. §103(a) is respectfully requested.

Claims 3, 5, 6 and 13 depend, directly or indirectly, from independent claim 1, which is allowable for at least the reasons set forth above. Accordingly, at least by reason of their dependency from an allowable claim, dependent claims 3, 5, 6 and 13 are also in allowable condition. Reconsideration and withdrawal of the rejection of claims 3, 5, 6 and 13 under 35 U.S.C. §103(a) is respectfully requested.

Claim 4 (previously dependent from claim 1) has been rewritten in independent form, and has also been amended to further specify that the scintillation detectors comprise at least two layers of $\text{Lu}_x\text{Y}_{1-x}\text{AP}$, each of said layers having a different value of x so as "to provide appropriate differences in the time constant of the $\text{Lu}_x\text{Y}_{1-x}\text{AP}$ of the first layer and the electrical pulse shape of the $\text{Lu}_x\text{Y}_{1-x}\text{AP}$." Because amended claim 4 includes all of the limitations of independent claim 1, Applicant respectfully submits claim 4 is allowable for at least the same reasons set forth above with respect to claim 1. In addition, a dual layer scintillation detector as presented in amended claim 4 is clearly not taught or suggested by the cited prior art documents. An advantage of the referenced feature is that the scintillation detector has two different decay time constants and that the yttrium content not only influences the value of these decay times but also their relative amplitude. This makes the pulse shape much more sensitive to yttrium contamination than for any other crystal like LSO. With one time constant only, the amount of yttrium required in the matrix to produce enough timing difference between the two layers would have too much of an effect on the density and the stopping power of the detector. With a strong effect in the relative amplitude of the two fast (but different) components, the detector can be

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made much more effective by keeping a high density for both crystals, but also by retaining good timing properties.

Furthermore, it should be noted that the only working phoswich (phosphor sandwich - a combination of scintillators) known to the applicant to date are based on a fast crystal (LSO) and a slow crystal (GSO) at 60ms or BGO at 300ms. The two layer scintillator according to the present invention when used in a phoswich has a response time of 20ms. Accordingly, it is respectfully submitted that independent claim 4 is novel and inventive over these cited prior art documents.

For at least the reasons set forth above, withdrawal of the rejection of amended claim 4 under 35 U.S.C. §103(a) is respectfully requested.

Claims 7-12 and 15-16 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Chen et al. in view of Chval et al. as applied above, and further in view of Fitzpatrick (U.S. Patent No. 5,493,121).

Claims 7-12 and 16 have been cancelled from the application.

Claim 15 depends directly from independent claim 1, which is allowable for at least the reasons set forth above. Fitzpatrick does not remedy the deficiencies of the Chen/Chval combination. Therefore, dependent claim 15 is also in allowable condition at least by reason of its dependency from an allowable claim. Reconsideration and withdrawal of the rejection of claim 15 under 35 U.S.C. §103(a) is respectfully requested.

Claim 14 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Chen et al. in view of Chval et al. as applied above, and further in view of Cherry (U.S. Patent No. 6,552,348).

Claim 14 depends indirectly from independent claim 1, which is allowable for at least the reasons set forth above. Cherry does not remedy the deficiencies of the Chen/Chval combination. Therefore, dependent claim 14 is also in allowable condition at least by reason of its dependency from an allowable claim. Reconsideration and withdrawal of the rejection of claim 14 under 35 U.S.C. §103(a) is respectfully requested.

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New Claims

New claim 20 (depending from claim 4) has been added to the application. No new matter has been added to the claims, as the subject matter of claim 20 is identical to that of claim 6 (depending from claim 3).

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CONCLUSION

In view of the above, Applicant respectfully submits that pending claims 1, 3-6, 13-15 and 20 are in form for allowance and are not taught or suggested by the cited references. Therefore, reconsideration and withdrawal of the rejections and allowance of claims 1, 3-6, 13-15 and 20 is respectfully requested.

The Examiner is invited to contact the Applicant's representative at the below-listed telephone numbers to facilitate prosecution of this application.

Any inquiry regarding this Amendment and Response should be directed to Matthew B. McNutt at Telephone No. (612) 767-2510, Facsimile No. (612) 573-2005. In addition, all correspondence should continue to be directed to the following address:

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Respectfully submitted,

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Please grant any extension of time necessary for entry; charge any fee due to Deposit Account No. 500471.

CERTIFICATE UNDER 37 C.F.R. 1.8: The undersigned hereby certifies that this paper or papers, as described herein, are being deposited in the United States Postal Service, as first class mail, in an envelope address to: Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on this 18th day of April, 2006.

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